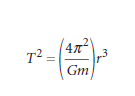
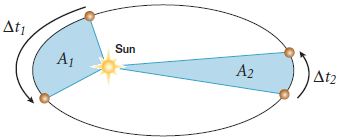
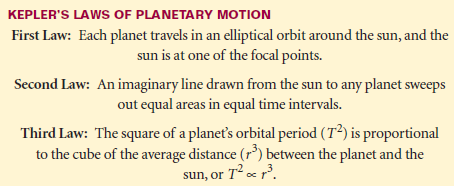
**PhET Simulation: Gravity and Orbits**  
Follow the directions carefully before answering the following questions while using the PhET simulation “Gravity and Orbits”. \*Highlight all your answers in a light color of your choosing. The simulation is located on the front page of the wikispace.

1. Run the simulation, Keep all the default settings, but select the *Earth and Satellite option*. Turn *on all of the options* in the “*Show”* menu, then run and play with the simulation for a while (5-10 min of play, then get on with this lab). **Which is experiencing a greater gravitational force: The satellite or the earth?**
2. Pause the simulation. Hit “Reset” (not “Reset All”). Alter the mass of the Satellite. **Does the mass of the satellite have any impact on its Orbit? Explain.**
3. Pause the simulation. Hit “Reset” Click and drag the “v” at the end of the red velocity in order to *decrease* the satellite’s velocity.
   1. **What happens when you hit play? Why?**
   2. **Why doesn’t this (your answer to ‘a’, happen to satellites normally?**
4. Pause the simulation. Hit “Reset” Click and drag to *increase* the satellite’s velocity.
   1. **What happens when you hit play? Why?**
5. Pause the simulation. Hit “Reset” Click and drag the satellite itself to move it further away from earth.
   1. **What happens when you hit play? Why?**
6. Try to create another stable orbit that is further or closer to earth. **What other important variable is altered with this new orbit besides the distance between the Earth and the satellite?**
7. Just for fun. Click and drag earth to create a very small velocity for earth. **Can the satellite still orbit a moving planet effectively?**
8. Pause the simulation. Hit “Reset” Click the “To Scale” tab, changing your view so that you are *to scale*. In the *Show* menu, you can now also turn on the “Tape Measure”. Run the simulation, with the path shown.
   1. **How far out is the satellite?**
   2. **How long does it take for the satellite to orbit earth?**
9. Switch modes, so that you are now looking at just the earth and the moon.
   1. **How far is the moon?**
   2. **How long does it take for the moon to orbit the earth?**
10. Again switch modes, so that you are now looking at just the earth and the sun.
    1. **How far is the earth from the sun?**
    2. **How long does it take for the earth to orbit the sun?**
11. According to Kepler’s third law, the time it takes for one complete orbit is proportional to the average distance between the centers of two bodies. *T*2 ≈ *r*3. When a constant is included, the equation is **Use the adjustable mass controls on the simulation of just the earth and sun to determine what mass the “m” in Kepler’s equation must refer to. Is it the mass of the orbiting object or the mass of the central object? In other words, does the orbital period (time) depend on the mass of the orbiting body or center (parent) body?**
12. Kepler actually proposed three laws.



An illustration of Kepler’s 1st and 2nd Law is shown here: A1=A2. In this case you can see that when a planet is closer to the sun it must cover more distance in the same time for the areas in blue to be the same. **What can you conclude about the speed of a planet close to the Sun compared to when it is further from the Sun?**

Reset all. Select the Earth and Sun. Choose to show only the path and velocities. Manipulate the Simulation until you achieve an elliptical orbit. **What happens to the speed of the Earth as it orbits closer to the Sun and when it orbits further from the Sun?** (hint: move the sun itself)